AD 691864

AFAPL-TR-69-23

AN EVALUATION OF THE EFFECTIVENESS OF A STATIC DISSIPATOR FUEL ADDITIVE AFTER TRANSPORT IN A FULL SCALE FUEL DISTRIBUTION SYSTEM

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TECHNICAL REPORT AFAPL-TR-69-23

MAY 1969

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400 - July 1969 - CO455 - 84-1871

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FOREWORD

This report was prepared as a joint effort by the Fuels, Lubrication, and Hazards Branch, Support Technology Division of the Air Force Aero Propulsion Laboratory, Project 3048, Task 304805, and the Product Engineering Branch, Quality Division, Directorate of Air Force Aerospace Fuels, Kelly AFB, Texas, Project POL 67-16. Mr. Howard F. Jones (APFL), Mr. Eddie French (SAOQ), and Lt. William H. Stark (SAOQ) directed the study.

The work described in this report was conducted from January 1968 to August 1968.

The authors wish to express their appreciation to Mr. F. Carter, Canadian Armed Services Headquarters, and Mr. L. Gardner, National Research Council of Canada, for their invaluable assistance on this program.

This report was submitted by the authors on 7 February 1969.

This technical report has been reviewed and is approved.

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ABSTRACT

A test program was performed to determine the feasibility of blending a proven static dissipator additive, Shell ASA-3, into a fuel at a refinery, and transferring the product through a long distribution system to the using activity. The U. S. government owned pipeline complex connecting Loring AFB, Maine, with Searsport Storage terminal, which was receiving fuel from the Gulf coast area, was used for this test program. Test data obtained during the 8 months of the test program show that the conductivity of the fuel decreases to an unacceptable level from refinery to using activity, specific models of fuel quantity probes are adversely affected, and some types of corrosion inhibitors influence the fuel conductivity when used in combination with static dissipator additive ASA-3.

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INTRODUCTION

The flow of fuel through a pipeline or through filter media generates an electrical charge in the same manner as any dissimilar moving bodies in contact. Due to the relatively poor conductivity of the turbine fuels, rapid charge dissipation is impossible in the normal fuel handling systems. The electrical charge thus generated can build up to critical proportions which under the proper conditions can discharge in vapor spaces of the storage system, servicing trucks, or aircraft. These discharges may be of sufficient intensity to cause an explosion or fire. One method of minimizing this hazard is by the addition of metallo-organic compounds which will increase the conductivity of the fuel thus enabling a more rapid dissipation of any static charge which might be generated in the system.

While much data has been accumulated on the use of fuel containing a static dissipator additive in aircraft, no information has been obtained on the depletion rates of the additives which could be expected in a full-scale fuel distribution system which included ocean-going tankers and pipelines. The objective of the study discussed in this report was to gain this data on a proven static dissipator additive (Shell ASA-3) and provide information necessary to determine the optimum additive injection point which would provide the desired conductivity level throughout the base handling system. This program was also designed to gain a limited amount of data on (1) the effects of this additive on specification properties of large production batches of MIL-T-5624 grade JP-4 fuel; (2) determine if any gross changes in fuel filter/separator performance could be expected from use of the additive; and (3) determine if any problems would be encountered by the use of this additive on a relatively large number of operational USAF aircraft.

SECTION II

DISCUSSION

1. TEST PROGRAM

The test program involved the shipment of 470,597 barrels of ASA-3 treated JP-4 through five (5) separate handling systems which could be encountered in the normal transfer of fuel from the refinery to the point of servicing of the aircraft. Fuel was shipped from two gulf coast refineries by ocean-going tankers 3,000 miles into storage at the USAF Fuel Terminal at Searsport, Maine. Transportation time from refinery to storage terminal was approximately 7 days. It was then moved through a 200 mile pipeline into storage at the USAF Fuel Terminal, Limestone, Maine. Fuel from this terminal was transferred through a six (6) mile pipeline to the Loring AFB, Maine, fuel handling system and subsequently serviced to the Aircraft. Figure 1 shows an outline of the system used in this study. Testing was conducted throughout the system in accordance with the schedules outlined in Table I.

2. ADDITIVE BLENDING PROCEDURES

Fuel used in this test program consisted of four tanker shipments and was furnished from two refinery sources. Blending procedures used at each refinery source are outlined below.

Refinery A Blending was accomplished by diluting the required amount of concentrated ASA-3 in 25 gallons of ASTM aviation Jet A-1 and pouring this mixture through the top hatch of the JP-4 blend tank. The fuel tank was then circulated for a minimum of 8 hours and the conductivity determined. All operations have been done under the scrutiny of the Government Quality Control Representative. When the tank capacity did not permit blending of sufficient product to fill a tanker lifting requirement, ASA-3 was blended directly in ship tanks. This procedure was used on one 20,000 barrel quantity by loading approximately 3 feet of product into the ships tanks, adding the necessary amount of additive to the tank, and filling the remaining volume with product, thereby, utilizing the filling circulation to disperse the additive

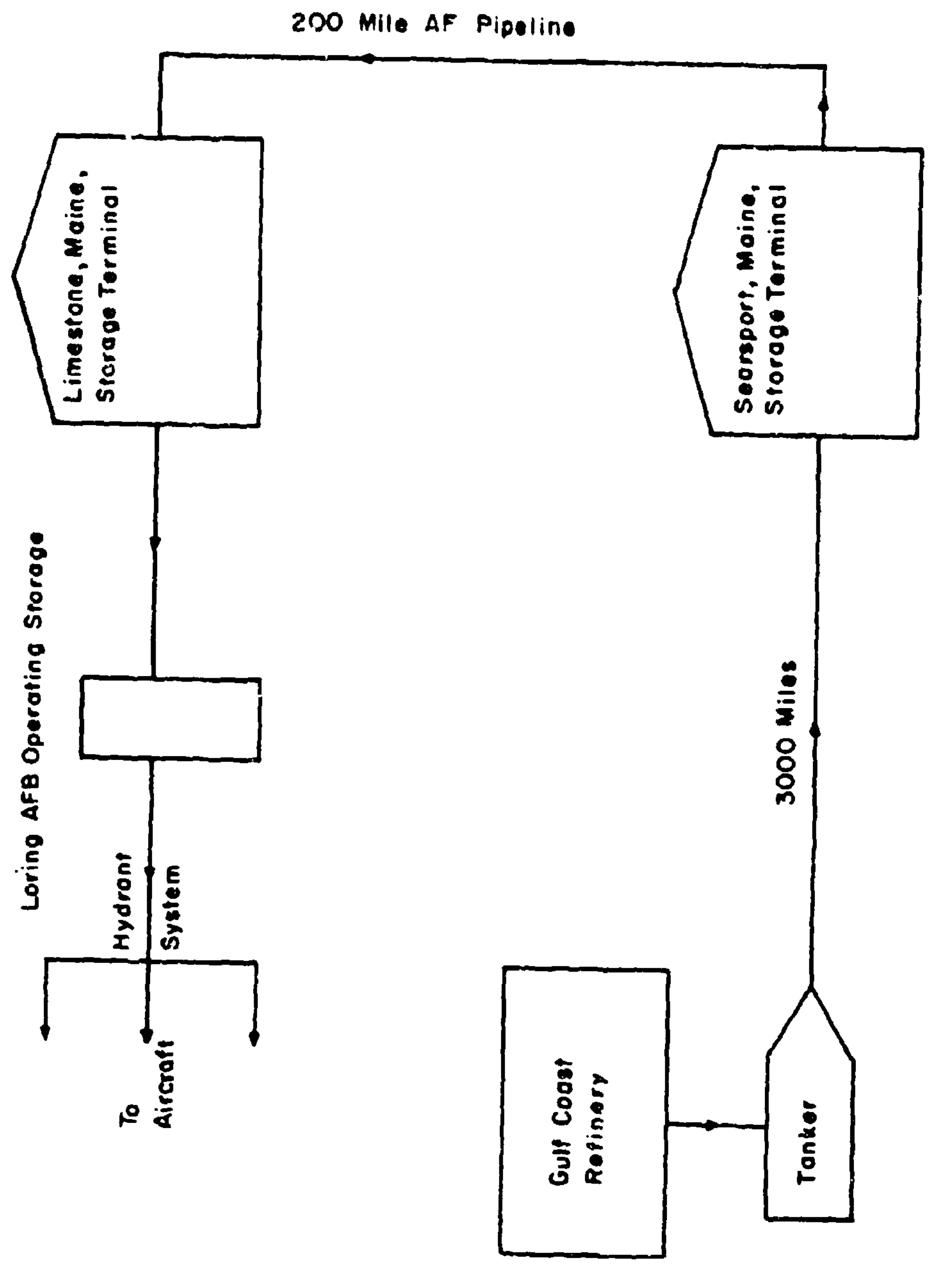

Figure 1. Schematic Fuel Distribution System

TABLE I

FUEL TESTING SCHEDULE

Tests Required	Sample Source and Frequency of Test				
	Tanker Refinery	Tanker Searsport	Searsport Terminal	Limestone Terminal	Loring AFB Op. Storage
Full Specification	After Loading				
Routine QC	After Loading	Prior to Discharge	Monthly	Monthly	
Conductivity	After Loading	Prior to Discharge	Weekly	Weekly	Daily
WSIM	Before and After ASA-3		Weekly	Weekly	Weekly

Refinery B Procedures utilized by this refinery differed from that of Refinery A in that the ASA-3 was injected directly into the tanker loading line using two proportioning pumps. Both methods appear to give satisfactory results.

3. ADDITIVE CONCENTRATION

Since the prime objective of this program was to determine the changes in conductivity levels of the fuel throughout the transportation system and not additive effectiveness, the static dissipator was blended in all batches at a concentration level of 1.0 ±0.1 ppm rather than to a specific conductivity level. Electrical conductivity measurements were accomplished in situ in vessel tankage prior to departure from the refinery. These data were used as the base line to estimate changes in additive concentration throughout the fuel distribution system.

4. FUEL CONDUCTIVITY

Fuel conductivities were measured from the refinery to the using activity in accordance with the schedule outlined in Table I, using ASTM Method D2624. These measurements recorded in Table II, were corrected to 60°F so that any changes in conductivity throughout the system would be readily apparent. Conductivity readings reported for Loring AFB in this table have been consolidated to show the daily average reading on all tanks. The high and low conductivities on any given day did not exceed ±8 picomhos per meter for this activity. All other data are actual readings as reported.

A total of four (4) shipments of fuel were transported from the Gulf Coast to Searsport, Maine, during this program. Shipments 1 and 3 were supplied by refinery "A" and were loaded on 19 January 1968 and 17 March 1968. These shipments arrived at Searsport, Maine on 29 January 1968 and 24 March 1968, respectively. Shipments 2 and 4 were supplied by refinery "B" and were loaded on 15 February 1968 and 26 April 1968. Shipment number 2 arrived at Searsport, Maine, on 24 February 1968 while shipment number 4 arrived on 7 May 1968. All shipments except number one (1) lost its identity upon receipt into the Searsport storage through mixing with previous ASA-3 batches in the storage tanks and the pipeline system between Searsport and Limestone, Maine.

TABLE II

CONDUCTIVITY READINGS AT 60°F

Date	Gulf Coast Refinery Conductivity @60°F	Searsport Storage Terminal Conductivity @60°F Tanks			Limestone Storage Terminal Conductivity @60°F Tanks		Loring AFB Maine Distribution System Conductivity @60°F
		5	7	8	1	2	
19 Jan	610						
29 Jan		445					
6 Feb		228					
13 Feb		255					
15 Feb	595	244					
24 Feb		280	209	255			
7 Mar		201	191	214			
17 Mar	375						
21 Mar		230					
24 Mar		215		230			
25 Mar		265		240			
3 Apr		200		250	140	150	
8 Apr				210	130	140	
11 Apr					130	135	68
12 Apr							78
13 Apr							72
15 Apr							72
16 Apr		250			130	135	85
17 Apr							80
18 Apr							76
19 Apr					127	130	78
22 Apr		210		255	117	125	83
23 Apr							78
24 Apr					115	122	82
25 Apr							93
26 Apr	255						89
29 Apr							89
30 Apr		210		265	122	127	96
1 May							96
2 May							96
3 May		220		250	117	125	98

TABLE II (CONTD)

Date	Gulf Coast Refinery Conductivity @60°F	Searsport Storage Terminal Conductivity @60°F Tanks 5	7	8	Limestone Storage Terminal Conductivity @60°F Tanks 1	2	Loring AFB Maine Distribution System Conductivity @60°F
6 May							98
7 May		470		290			100
8 May					105	116	101
9 May							101
10 May							100
13 May		410		300	105	115	101
14 May							101
15 May							100
16 May					103	114	100
17 May							95
20 May		460		310			
27 May		470		310			
1 Jun		450		310			
10 Jun		420		300			
13 Jun		390		300			60
14 Jun					60	67	60
17 Jun							60
18 Jun		430		290	61	65	56
19 Jun							57
20 Jun							57
21 Jun		430		330	61	65	59
24 Jun							57
25 Jun					53	55	59
26 Jun							57
27 Jun		420		350	52	56	57
28 Jun							59
1 Jul					51	54	57
2 Jul		420		360			59
10 Jul							83
11 Jul							88
12 Jul					61	61	88
15 Jul							92
16 Jul							93

TABLE II (CONTD)

Date	Gulf Coast Refinery Conductivity @60°F	Searsport Storage Terminal Conductivity @60°F Tanks			Limestone Storage Terminal Conductivity @60°F Tanks		Loring AFB Maine Distribution System Conductivity @60°F
		5	7	8	1	2	
17 Jul						60	91
18 Jul					96	60	91
19 Jul							87
22 Jul							91
23 Jul					100	72	91
24 Jul							94
25 Jul					109	95	95
26 Jul							97
29 Jul							100
30 Jul					102	107	95
31 Jul							96
1 Aug					102	107	97
2 Aug							98
5 Aug							97
6 Aug							96
7 Aug							91

The data shown in Table II with one exception, shipment number 4, shows a steady decrease in conductivity throughout the transportation system. This ›nt increase in conductivity of 215 picomhos noted from the refinery to ~ .sport, Maine for shipment number 4 may be the result of measuring the conductivity before the ASA-3 had completely ionized in the blended fuel. This explanation appears probable since Batch 1 showed an increase in conductivity of 235 picomhos per meter over a four day period from the time of blending in the refinery tanks to completion of the tanker loading operation.

All other data appears to be self explanatory except for the 24 picohmo increase in conductivity at Loring AFB between readings taken on 2 July and 10 July. This increase was thought to be the result of the change in the meter used at Loring AFB, as shown in Table III. This explanation however, was not considered valid after analysis of the meter calibration data supplied by the National Research Council of Canada (Table IV) and the readings taken at the Limestone Terminal after that date. No increase in the fuel conductivity was noticed in the Limestone storage tanks until receipt of new fuel into tank number 1 on 18 July when an increase of 34 picomhos occurred.

The overall analysis of this data, as stated previously, shows a steady decrease in conductivity throughout the system. At no time in the program did the conductivity at the using activity meet the recommended concentration levels of 150 picomhos/meter to 450 picomhos/meter at 60°F. Data does indicate that the conductivity appeared to be stabilizing at individual points in the system from Searsport to Loring AFB toward the end of the program. However, because of the large losses between these points in the pipeline system, it is not believed that the conductivity levels recommended for servicing to the aircraft could be reached or maintained in this system without supplying additional additive at some intermediate point, such as the beginning of the pipeline at Searsport or just prior to entering the storag· tanks at Limestone, Maine.

5. EFFECT OF STATIC DISSIPATOR ADDITIVE ASA-3 ON FUEL CHARACTERISTICS

Test data on all specification MIL-T-5624, Grade JP-4 requirements are summarized in Table V. The only fuel characteristic affected by the static

TABLE III

MAIHAK CONDUCTIVITY INDICATORS
LOCATION AND DATES OF USE AT EACH ACTIVITY

INDICATOR NO.	REFINERY "A"	REFINERY "B"	SEARSPORT	LIMESTONE/ LORING AFB
64022	Shipment 1 & 3	Shipment 2		5 June to 3 July 1968
64034				9 April to 21 May 1968
64043		Shipment 4		
64076			29 Jan to 3 July 1968	5 July to August 1968

TABLE IV

MAIHAK CONDUCTIVITY INDICATORS CORRELATION DATA

Meter Number	Electrical Conductivity, Picomho/m 76°F					
	Fuel A	Fuel B	Fuel C	Fuel D	Fuel E	Fuel F
64034	50	210	460	60	170	415
64043	45	200	475	50	165	400
64076	60	235	535	60	190	470
64022	50	200	480	50	170	430

TABLE V

PROCUREMENT SPECIFICATION TEST RESULTS

Test	Specification Requirements	TEST RESULTS Batch 1	Batch 2	Batch 3		Batch 4
Quantity Shipped, Gals.		84,986	151,679	96,791		137,141
Gravity, °API @ 60°F	45-57	54.1	56.8	56.2	54.2	55.8
Reid Vapor Pressure PSI @ 100°F	2.0 - 3.0	2.7	2.5			2.8
Sulfur, Wt. %	0.4 max.	0.0023	0.01	0.013	0.0115	0.01
Mercaptain Sulfur, Wt. %	0.001 max.	0.001	0.001	.0002	.0002	0.001
Potential Gum, Mgs./100 ML.	14.0 max.	1.4	3.0	0.8	0.4	Nil
Existent Gum, Mgs./100 ML.	7.0 max.	0.6	1.0	0.6	0.4	Nil
Freezing Point, °F	-72 max.	<- 95.0	<-80	-88.6	-88.6	-76
Aromatics, Vol. %	25 max.	19.0	10.5	14.0	12.5	13.0
Olefins, Vol. %	5 max	2.0	0.5	0.5	1.0	0.5
Water Reaction, Interface Rating	1B max.	1	1.0	1	1	1
Corrosion, Copper Strip, ASTM	1 max.	1	1	1	1	Pass
Initial Boiling Point, °F	Report	148	154	160	202	156
10% Evaporated °F	Report	216	186	216	228	176
Vol. % Evaporated @ 290°F	20 min	49.5	63	45.0	42.0	58
Vol. % Evaporated @ 370°F	50 min	83.0	89	81.0	74.5	86
Vol. % Evaporated @ 400°F	Report	91.0	94	92.0	83.0	92
Vol. % Evaporated @ 470°F	90 min.	99.0		-	-	-
End Point, °F	Report	456	438	442	436	443
Residue Vol. %	1.5 max.	1.0	1.2	1.0	1.0	1.0
Loss Vol. %	1.5 max.	1.0	0.8	1.0	1.0	1.0
Aniline Gravity Product	5250 min.	6687	7185	6666	7360	6795
Smoke Volitility Index	52 min.	61.2	67.5	65.6	60.9	65.6
Thermal Stability @ 300/400°F						
ΔP 5 hrs. in. Hg	3" max.	0.4	0.0	0.5	0.3	0.1
Preheater Deposit Code	< 3	0	1	1	1	1
Fuel System Icing						
Inhibitor % Vol.	0.10 - 0.15	0.13	0.11	0.14		0.12
WSIM						
Before Addition of ASA-3	70	81	95	98	85	86
After Addition of 1 ppm ASA-3	Report	57	76		49	58
Corrosion Inhibitor,						
Santolene-C #/1000 BBLS.	4.0 - 16.0	5.0	4.0	5.0	5.0	4.0
Static Dissipator Additive						
ASA-3, ppm	1.0 ±0.1	1.0	1.0	1.0	1.0	1.0
Conductivity, Picomhos/Meter @ 60°F	Report	370	595	375		255

dissipator additive Shell ASA-3 was the Water Separometer Index Modified (WSIM). Reductions ranging from 19 to 36 numbers were noted after the addition of the ASA-3.

WSIM ratings were monitored at all points in the distribution system in accordance with the schedule shown in Table I. ASTM test method D-2550 was used for obtaining this data on fuel from the Refinery, Searsport Storage Terminal and the pipeline. Since a standard WSIM apparatus was not available at the Limestone terminal, a new experimental apparatus, the Esso Mini Separometer, was used to obtain the WSIM ratings reported on fuel samples obtained from the Limestone Terminal and the Loring AFB operational storage system. The USAF Aero Propulsion Laboratory has completed a small scale test program on this equipment. WSIM ratings, correlated favorably with those obtained by the standard WSIM test apparatus.

WSIM test results for the ASA-3 program are shown in Table VI. All data with the exception of that reported for Batches 1, 2, 3, and 4 are average results for each location. Data from these batches represent the fuel from the refinery to receipt at Searsport Terminal. At this point, with the exception of Batch 1, identity of the product was lost due to mixing with previous batches of ASA-3 treated fuel. This data shows a significant decrease in WSIM ratings after the addition of ASA-3. In addition, a significant decrease is also noted after addition of corrosion inhibitor during movement of the fuel in the pipeline system. This decrease in WSIM appears to be recovered by the time the fuel reaches Limestone, Maine, indicating that the majority of the corrosion inhibitor added at Searsport is being plated out in the pipeline system. No major changes in WSIM can be noted in fuel during storage and handling in the Searsport, Limestone, or Loring AFB systems.

6. EFFECTS OF ASA-3 ON AIRCRAFT SYSTEMS

The aircraft stationed at Loring AFB Maine, which used the fuel containing the static dissipator additive on a continuous basis during the test program are as follows: B-52, KC-135, F-106. No problems were encountered in these aircraft systems. Dow Air Force Base, although not specifically included in the test program, received fuel at an intermediate point on the Searsport to Limestone pipeline. Fuel with static dissipator additive was used to service

TABLE VI

AVERAGE MONTHLY WSIM RATINGS

	Before ASA-3	After ASA-3	Searsport Storage	Pipeline	Limestone Storage	Loring AFB Storage
Batch 1	81	57	46			
Batch 2	95	76	60			
Batch 3	85	49	70			
Batch 4	86	58	84			
February 1968			60	51		
March 1968			60	-		
April 1968			69	62	63	64
May 1968			79	57	72	72
June 1968			69	44	64	67
July 1968					75	
7 August 1968						
15 August 1968						
Non-ASA-3 Fuel					85	83
			TEST COMPLETE			

F-89J aircraft stationed at Dow AFB. Erroneous fuel quantity readings were reported by pilots flying these aircraft. Investigation of the reported problem showed that the fuel quantity probes manufactured by Avien Corp., part numbers 165-047-454, 165-147-993, 165-077-713, 165-077-722, 165-077-12922, 165-090-633, PN165-047-455, 165-047-994, 165-077-716, 165-077-724, 165-077-1293, 165-047-461, P165-077-710, 165-077-718, 165-077-726, and 165-077-1506 gave low resistance readings when operating on fuel containing the static dissipator additive. These probes are constructed of metal tubes making up the capacitor plates. Fuel quantity probes manufactured by Avien Corp., part number 165-0513-B2008 which were used in a small number of these aircraft, were not affected by the fuel containing the static dissipator additive. These fuel probes were constructed of Phenolic material with characterized printed plates. Test data is summarized in Table VII.

7. FILTER/SEPARATOR PERFORMANCE

The filter/separators, a vital component in the fuel handling system at all US Air Force Bases, were observed during this study to determine the effects of the static dissipator additive on performance. The filters in specific filter/separators units were removed at the start of the test program for comparison with filter/separator elements at the completion of the test program. Also this procedure assured that new elements were placed in the system, thus eliminating the chance that deterioration of the filter/separator element had occurred prior to the start of the test program. All filter/separator elements met the performance requirements of MIL-F-8901. During the test program no filter separator element replacements were necessary due to high differential pressure or other evidence of degradation. Evaluation of the filter/separator elements at the completion of the test program showed that no excessive degradation of the filter elements performance had occurred due to 5 months use of the static dissipator additive.

8. TEMPERATURE EFFECTS

The fuel used in this test program originated in a relatively warm area - the Gulf Coast of the United States. At the time of blending at the refinery, the fuel temperature was approximately 65°F. The loaded tankers traveled through

TABLE VII

EFFECT OF STATIC DISSIPATOR ADDITIVE ON FUEL QUANTITY PROBES

	Tank Units with Metal Tubular Plates	Tank Units with Phenolic Tubes and Printed Metallic Plates
Fuel with Static Dissipator Additive Conductivity 360 Picomhos @ Test Temp.	500 meg OHMS	8,000 meg OHMS
Fuel with Static Dissipator Additive Conductivity 120 Picomhos @ Test Temp.	1,200 meg OHMS	10,000 meg OHMS
Fuel without Static Dissipator Additive Conductivity 20 Picomhos @ Test Temp.	9,000 meg OHMS	10,000 meg OHMS

the warm waters of the Gulf of Mexico to the colder areas of the Atlantic Ocean near Searsport, Maine, where the temperature of the fuel was reduced to approximately 30°F. This resulted in a decrease in temperature of approximately 35°F. While some loss of conductivity was observed from the refinery to Searsport, Maine, the effects of these temperature changes on the conductivity were not determined, but must be considered in the overall evaluation of the data.

9. CORROSION INHIBITORS

The two corrosion inhibitors used throughout this program have been Santolene "C" and AFA-1. Both products are qualified in accordance with Specification MIL-I-25017. At the time of the initial blending, all four batches of fuel contained Santolene "C" at a concentration of 4-5 pounds per 1000 barrels. Corrosion inhibitor was injected into all fuel transported in the 200 mile Searsport to Limestone pipeline at a concentration of 7 pounds per 1000 barrels of product. In the initial shipments of fuel from the storage tanks at Searsport, some changes in the conductivity of the fuel were noted on line samples after injection of the corrosion inhibitor. A laboratory test program was established to determine if the corrosion inhibitor was influencing the fuel conductivity. Nine samples (five gallons each) of non-additive fuel were blended as follows:

A	JP-4 + FSII
B	JP-4 + FSII + ASA-3
C	JP-4 + FSII + Santolene "C"
D	JP-4 + FSII + Santolene "C" + ASA-3
E	JP-4 + FSII + AFA-1
F	JP-4 + FSII + AFA-1 + ASA-3
B_2	JP-4 + FSII + ASA-3
D_2	JP-4 + FSII + Santolene "C" + ASA-3
F_2	JP-4 + FSII + AFA-1 + ASA-3

The corrosion inhibitor concentration selected for this test was 10.0 #/1000 barrels for both inhibitors. FSII + ASA-3 concentration was set at 0.15% and 1.0 ppm nominal, respectively, at the time of blending. Conductivity of the

samples were measured over a one week period. Test results and testing frequency are shown in Table VIII.

As can be noted from these test results, the AFA-1 and the Santolene "C" do not appear to have any effect on the conductivity of the base fuel; however, Santolene "C" used in conjunction with ASA-3 increases the conductivity over that of the fuel containing ASA-3 alone. Conversely AFA-1 decreases the conductivity level below that of the fuel containing ASA-3 alone. This apparently is due to some reaction of the constituents of the inhibitors with the metallic ions in the ASA-3. The differences in the effects caused by these two inhibitors may be related to the wide differences in the acidity levels of Santolene "C" and AFA-1.

TABLE VIII

INFLUENCE OF CORROSION INHIBITOR ON FUEL CONDUCTIVITY

SAMPLE	CONDUCTIVITY PICOMHOS/METER			
	10 Dec 68	11 Dec 68	12 Dec 68	16 Dec 68
A	-	-	5	0
B	290	315	365	325
C	0	0	0	0
D	620	470	550	485
E	0	0	0	0
F	-	205	230	215
B-2	-	300	375	355
D-2	-	650	570	515
F-2	-	190	230	225

SECTION III

CONCLUSIONS

1. The blending of a static dissipator additive at the petroleum refinery and subsequent transfer through a system such as that used in this test program will not permit desired fuel conductivity at the point of aircraft servicing.

2. While some stabilizing effect is noted in the latter portion of the test program in the amount of conductivity lost during transfer, it is concluded that the loss in fuel conductivity from refinery to user in the type of system used for the test is valid and continuous losses will occur.

3. The use of a fuel containing a static dissipator additive renders some types of fuel quantity probes used in USAF aircraft inoperable and causes erroneous fuel quantity readings resulting in mission aborts.

4. Filter/separator performance did not appear to be significantly affected by fuel containing a static dissipator additive in the concentration encountered at Loring AFB, Maine.

5. Corrosion inhibitors show a definite effect on the fuel conductivity when used in combination with the static dissipator additive, ASA-3. Data on the two corrosion inhibitors used in this program does not show a definite effect of corrosion inhibitor on conductivity when used alone.

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Air Force Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio 45433 and Directorate of Air Force Aerospace Fuels, Kelly AFB, Texas	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

AN EVALUATION OF THE EFFECTIVENESS OF A STATIC DISSIPATOR FUEL ADDITIVE AFTER TRANSPORT IN A FULL SCALE FUEL DISTRIBUTION SYSTEM

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

5. AUTHOR(S) (First name, middle initial, last name)

Howard F. Jones, Air Force Aero Propulsion Laboratory
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6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
May 1969	26	

8a. CONTRACT OR GRANT NO. b. PROJECT NO. 3048 c. Task No. 304805 d.	9a. ORIGINATOR'S REPORT NUMBER(S) AFAPL-TR-69-23 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

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11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY
	Air Force Aero Propulsion Laboratory Wright-Patterson Air Force Base, Ohio

13. ABSTRACT

A test program was performed to determine the feasibility of blending a proven static dissipator additive, Shell ASA-3, into a fuel at a refinery, and transferring the product through a long distribution system to the using activity. The U. S. government owned pipeline complex connecting Loring AFB, Maine, with Searsport Storage terminal, which was receiving fuel from the Gulf coast area, was used for this test program. Test data obtained during the 8 months of the test program show that the conductivity of the fuel decreases to an unacceptable level from refinery to using activity, specific models of fuel quantity probes are adversely affected, and some types of corrosion inhibitors influence the fuel conductivity when used in combination with static dissipator additive ASA-3.

DD FORM 1 NOV 65 1473

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Jet Fuel Static Dissipator Additive Hydrocarbons JP-4 Fuel						